

## Changes in Antimicrobial Resistance in *Salmonella enterica* Serovar Typhimurium

**To the Editor:** The conclusion by Davis and colleagues (1) that use of antimicrobial agents in agriculture is unlikely to have contributed to the emergence of multidrug-resistant *Salmonella* serotype Typhimurium DT104 (MR-DT104) is contrary to available evidence. Use of antimicrobial agents in aquaculture in Asia may have contributed to the emergence of DT104. The resistant determinants of MR-DT104 reside on the chromosome, apparently within a transferrable element (2-4). Chloramphenicol resistance in MR-DT104 is due to *floR*, a florfenicol resistance gene (5); florfenicol is a veterinary antimicrobial agent that, although not approved in the United States until 1996, has been used in aquaculture in Asia since the early 1980s. *FloR* was first identified in *Photobacterium damsela*, a bacterium found in fish (5). Furthermore, tetracycline resistance in MR-DT104 is due to a class G resistance gene first identified in *Vibrio anguillarum*, a pathogen of fish (4,6). The molecular sequence where the class G and *floR* determinants reside on the DT104 chromosome is closely related (94% identity) to a plasmid in *Pasteurella piscicida*, another pathogen of fish (7). These data suggest that the resistance determinants of MR-DT104 may have emerged among bacteria in aquaculture and been horizontally transferred to *S. Typhimurium* DT104.

Spread of MR-DT104 between regions during international travel, as Davis and colleagues suggest, is unlikely because in industrialized countries *Salmonella* is seldom transmitted from person to person (8). Once MR-DT104 emerged, it spread rapidly to many regions through unknown means. The rapid emergence of MR-DT104 suggests a means of spread more efficient than person-to-person transmission. Possibilities include movement of infected breeding or "multiplier" stock or shipment of contaminated feed ingredients; such movements may not be as limited as Davis et al. suggest. For example, the international spread of *Salmonella* serotype Agona was traced to the global distribution of contaminated fish meal from Peru (9).

Once MR-DT104 is introduced into food animals in a region, use of antimicrobial agents in animals would contribute to further dissemination of MR-DT104 (8). If MR-DT104 is present on a farm, the use on the farm of any antimicrobial agent to which MR-DT104 is resistant would contribute to its persistence. An example of such use in cattle in the United States is the tetracycline-containing milk "replacement" commonly fed to dairy calves. This product could kill susceptible gastrointestinal flora while allowing tetracycline-resistant flora such as MR-DT104 to survive and proliferate. Once MR-DT104 proliferates on a farm, dissemination to other farms in the region is facilitated, particularly if the other farms are using an antimicrobial agent to which MR-DT104 is resistant.

Increasing antimicrobial resistance in *Salmonella* contributes to its spread and threatens the use of clinically important antimicrobial agents. To slow the emergence and dissemination of resistant *Salmonella*, measures should be implemented to ensure that antimicrobial agents are used prudently in food-producing animals (10).

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## References

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